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ABSTRACT

Defining productivity as the complex of factors that determine how efficiently an economy will operate, this booklet for Canadian secondary school students analyzes the subject in five sections. "What Is Productivity?" discusses output/input relationships when producing goods and services. "Why Is Productivity Important?" discusses the role of productivity in decreasing inflation and in improving the standard of living. "What Determines the Level of Productivity?" analyzes factors such as the structure of the economy, the state of the economy, and the scale of operations (the point at which the size of an operation increases and specialization at intermediate stages of the operation becomes profitable). The quality and quantity of capital (equipment used by labor in production), the labor force, and the role of government are also discussed. "Measuring Productivity" deals with problems concerning measurement and the use of statistics. The concluding section outlines the efforts that business, labor, and the government must make to increase economic efficiency in Canada. (KC)

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Understanding Productivity

Libby Joyce

The Canadian Foundation for Economic Education is a federally-chartered, non-profit organization. Non-partisan in its approach the Foundation is committed to increasing an understanding of economic matters, both nationally and on a personal level, through encouraging and assisting with the teaching of economics.
This booklet on Understanding Productivity is the second of a series on Understanding Economics.

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Preface

This report in the Understanding Economics series deals with an issue that is at the very heart of the whole subject. It attempts to set out in basic terms the complex of factors that determine how efficiently an economy will operate. This is the essential meaning of "productivity", and as such it raises universal questions that are of relevance to any economy, no matter how organized.

"Productivity" stands apart from the current issues of "growth" or "no growth", with which it tends to be confused. Whatever the economic objectives may be, (and they do change from time to time), there is no dispute about the proposition that we should be achieving them as fully and effectively as possible within our means. Anything else will only divert time, energy and resources from more productive (and usually more pleasant) uses.

Don't be misled by the carefully precise language of the present pamphlet into thinking that this is an arid subject.

On the contrary it is central to most of the current controversies about economic performance and the sharing of the economic pie. In this debate, business, labour and government are all actively engaged. There seems to be agreement only on the proposition that productivity is an issue of fundamental importance, but beyond that even the facts are in serious dispute. Has productivity been increasing or decreasing in recent years? If there are shortfalls is it the fault of labour, management, capital investment, government, foreign ownership or half a dozen other influences? What effort if any has productivity had on inflation? How do we compare with other countries, particularly our closest economic neighbour, the United States? Has productivity affected our ability to export? By no means least, what is the fair sharing of the fruits of productivity between labour, management, shareholders, governments, and various other interests having a claim on the economic process? This is a key issue – in effect the issue of income distribution – that is central to much current economic controversy.

It is not the function of the Foundation to attempt to answer any of the questions raised, much less to reconcile the issues at stake. These are the stuff of current debate and daily events, whereas our purpose is to set forth the fundamental elements of an economic phenomenon. However, if the debate produces material that illuminates the issues further in a reasonable way, we will be prepared to pass it on, as we have with other subjects.

J.H.P.

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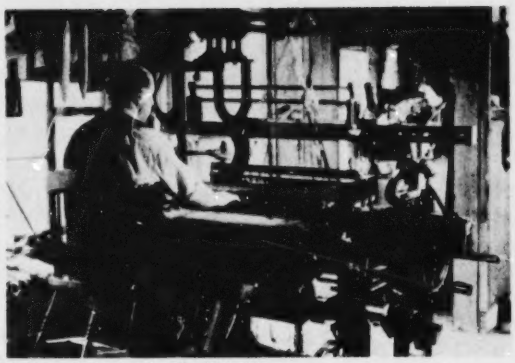


photo: The Wood Bureau of Canada Ltd.

Cottage industry in the Hebrides

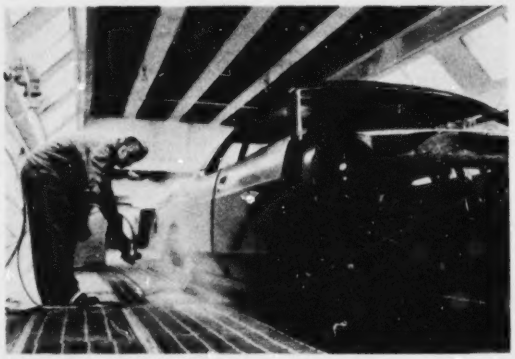


photo: Robert Ragsdale

Automobile assembly line

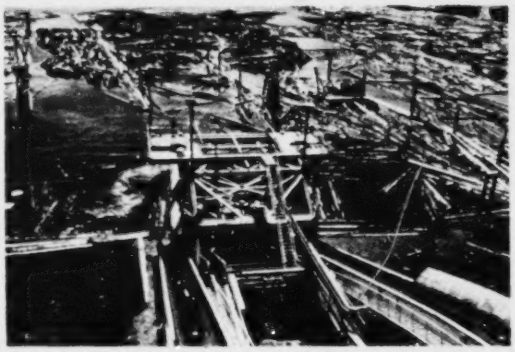


photo: MacMillan Bloedel Ltd.

Logs travelling up the twin jack-ladders at MacMillan Bloedel's Powell River Mill

Introduction

In Canada, as in all the industrialized countries of the world, much attention and effort are devoted to the production of goods and services. Income and wealth are generated by this process, and the Canadian "standard of living" depends on its results.

The total production of goods and services in Canada has varied over the years, and has differed from the levels of production in other countries. The production level in any country depends on innumerable factors, the most basic being the resources that are available to the country and the manner in which these resources are combined in production. One of the functions of an economic system is to encourage the most efficient combination of resources, in a way that is consistent with the overall objectives of the society.

Efficiency implies different things to different people, but in general it has to do with minimizing waste. It has to do with achieving a desired result with the least amount of effort. In economic terms, efficiency is related to productivity.

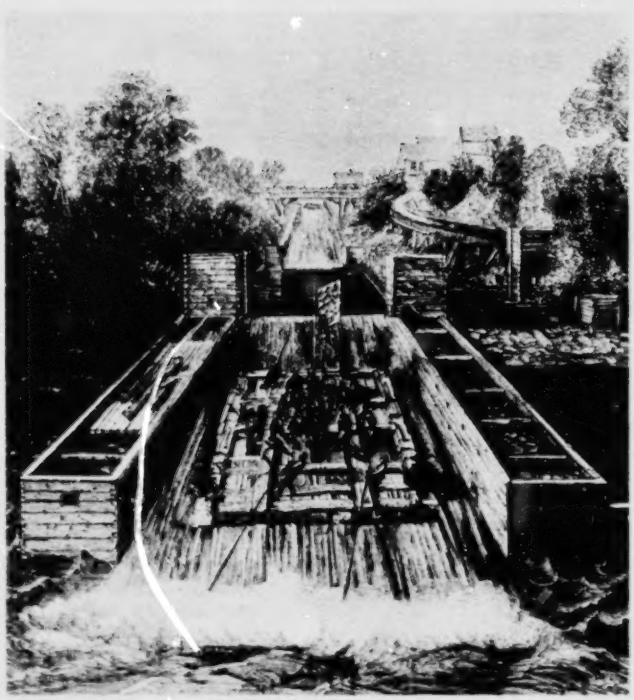


photo: Robert Ragsdale; courtesy Metropolitan Toronto Central Library

His Royal Highness Descending a Timber Slide

The Illustrated London News, October 7, 1860

"When Albert Edward, Prince of Wales, was to undergo this experience, how much greater than usual was the interest taken in the running of the crib. Everything, luckily, went well, both with the Prince's raft and with that which was carrying the leading members of the press immediately following."

The development of specialized technology has led to increased productivity in the logging industry, where inventive solutions have been found to problems posed by Canada's climate and geography.

Woodcut: Metropolitan Toronto Central Lib.

Clearing land

photo: Abitibi Paper Co. Ltd.

"Forwarding" lumber the new way

photo: Abitibi Paper Company Ltd.

"Forwarding" lumber the old way

What is Productivity?

Productivity is a measure, like "kilometres per hour" (km/h) or "revolutions per minute" (rpm). It is defined as "units of output per unit of input". This relationship compares the quantity of a desirable good or service produced (output) to the quantity of scarce resources used up in producing that good or service (input). If a relatively large amount of output (goods and services) is being produced using a relatively small amount of input (resources), productivity is high. If the reverse applies, it is low.

Note, however, that the above statement twice uses the term "relatively"! Large amounts and small amounts can only be judged relative to some other situation. Furthermore, as a measure like km/h or rpm, productivity is neither good nor bad in itself. Productivity measures must be considered along with other relevant information before they can be assessed. That is, the technical realities of output/input relationships must be viewed with reference to their accompanying market realities. These market realities involve output prices and input costs.

Productivity measures can take as many forms as there are combinations of output and input. In practice, however, only "labour productivity" ratios are calculated regularly for the Canadian economy, because they're easiest to calculate and because they tell a good deal about the performance of the economy. The form taken by these labour productivity ratios relates the physical product of an industry to the labour time required to produce that output. These ratios are generally expressed by the terms output per man-hour* or output per person employed.

Labour productivity statistics can be misleading, because they relate all increases in output to only one input – labour. Labour is among the most important resources used in any production process, but it is not the only factor to consider. For example, increases in "labour productivity" in agriculture, as measured by output per man-hour worked, may be due to good weather. Similarly, improved "labour productivity" in manufacturing may result from workers' using higher quality machinery. As Statistics Canada warns in its publication Aggregate productivity measures 1946–1974:

> "It must be emphasized that changes in output per unit of labour input cannot be attributed directly and solely to labour. These measures reflect not only changes in the skill and effort of the labour force, but also the contribution of other productive resources and the effectiveness with which all are combined and organized for production."

One problem with using labour productivity as a measure of overall production efficiency is the implication that slower productivity growth is the result of changing attitudes toward work. Much has been written over the past few years about the death of the "work ethic", that strong sense of obligation that is rumoured to have been felt by job-holders in years past. Magazine articles chronicle the lives of economic "drop-outs". Labour market research indicates a lengthening period of job search among the unemployed, which may imply less personal concern (financial or otherwise) over unemployment, and more concern about the type of work to be done. Psychological research on worker attitudes generally involves small numbers of people, and experts have difficulty broadening their findings to the whole population. Thus, solid information on this issue is scarce. The important point, however, as the following explanation will show, is that there are many other influences of equal importance on productivity.

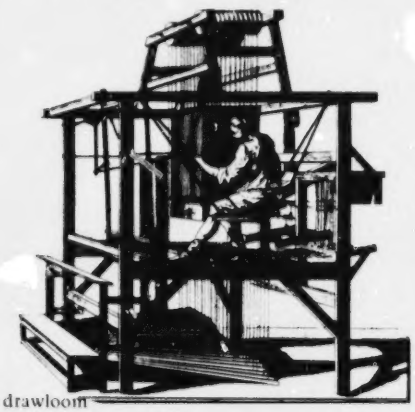
The use of labour productivity statistics as a measure of overall efficiency however does have the advantage that long term changes in labour productivity correspond closely to changes in broader productivity measures. Often this may be the simple result of labour's dominant role in production, which overrides output changes due to other factors of production. However, the similarity encourages analysts to look at labour productivity statistics as proxy measures of overall efficiency.

* *The term "output per man-hour" is used here because it corresponds with Statistics Canada's publication practices. These statistics also represent many hours of work performed by women. One "man-hour" is defined as one hour of work done by one person.*

Why is Productivity Important?

The "rising tide of human expectations" described by U.S. President John F. Kennedy in the early 1960s has been seen not only in the developing countries to which he referred, but also in the industrialized countries. Ever higher incomes have come to be expected by all. But if higher incomes are simply the result of more dollars being handed out (without increased availability of goods and services), prices will rise and there will be no real effect on living standards.

Inflation (an overall increase in the general price level) has been a major international concern in this decade. It is recognized as harmful to the functioning of an economic system, and yet it can occur as

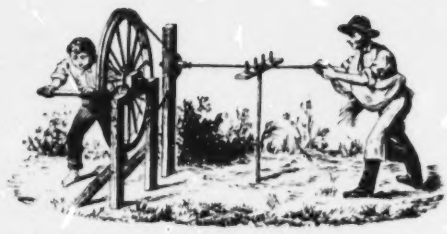


Simple drawloom

the result of increasing incomes, which are regarded as beneficial. Many experts argue that one way out of this circle is by increasing productivity. Their reasoning is that if output per worker increases, then income per worker can also rise proportionately without inflationary effects. This makes sense, although it cannot be taken for granted. There are so many other factors involved in inflation (e.g., government fiscal and monetary policy) that increased productivity alone could not cure it.

A counter-effect argued by some is that efficiency improvements eliminate jobs and thus reduce total labour income. For example, the increasing use of computers in the insurance industry has meant that clerks who used to process insurance policies are no longer necessary. Labour saving efforts,

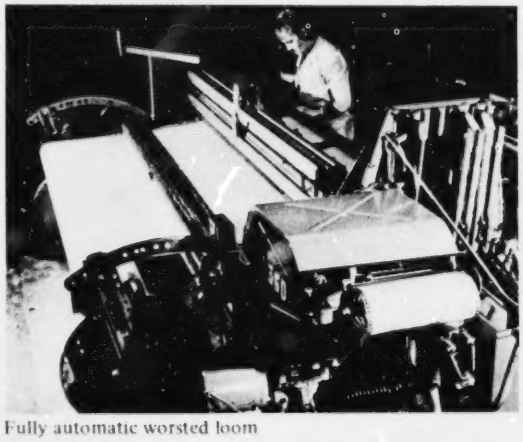
* *A process or method for handling some specific technical problem. This broad definition encompasses techniques in all production processes.*



Flax spinning

usually in the form of advancements in technology,* have undoubtedly caused some dislocation. Certain individuals pay a high price during adjustment to new technology. However, courses teaching these individuals skills useful in other areas enable them to share in the overall benefit to society from increased productivity. And jobs continue to be created. For example, in the insurance industry, the number of persons employed increased by nearly 40% from the mid-50s to the mid-70s, the period when computers were making their great impact. In addition, the human resources that were freed from clerical work in this industry were made available for other work. This experience is true of the whole economy. Total employment has grown by about 70% in the past 20 years, at the same time that labour-saving advances streamlined many production processes.

The productivity issues discussed above are mostly of interest in the short-run. In the long-run, productivity is important because it determines the degree to which Canadians can improve their "standard of living".



Fully automatic worsted loom

New technology has an impact on productivity in the home as well as in the workplace. The increasing entry of women into the labour force has been made possible by the introduction into the home of labour-saving appliances and other work aids. Homemaking has been streamlined by the development of the service industries, which have taken over many of the household tasks performed in Canada's early days.

Wilson's grocery store, Oakville, Ontario, about a hundred years ago

Our standard of living depends on many factors, and there is no official definition for it. In the absence of an agreed upon definition, income is often used as a substitute measure of living standards. In 1975, according to Statistics Canada, the average income of all Canadian families of four was $16,262. But in that year, nearly 20% of such families were earning less than half that amount. Regardless of the many non-income factors that influence living standards, these data suggest that many Canadians are probably living at a standard which is considered less than adequate for individual and family development in the area in which they live.

Productivity improvements can help raise the standard of living in Canada indirectly by enabling Canadians to sell their products in other countries at competitive prices. If we can produce certain commodities more efficiently than our trading partners, it is in their best economic interest to buy those commodities from us. This trade generates additional income in Canada, and thus enables Canadians to support increased, more varied and challenging employment in Canada.

The fastest way to raise the overall standard of living is by increasing total production and income. The Economic Council of Canada stated this simply in its 12th Annual Review: "Income and output are intimately related. Real income (that is, income unaffected by inflation) depends on output, so that any growth in real income requires growth in output." Such growth can be achieved in several ways. One way is to put more people to work. But there are obvious limits to this type of growth, and anyway, that wouldn't necessarily increase the income going to each worker. More capital and raw materials may be combined with the same amount of labour to improve labour productivity but the new combination could very easily waste non-labour resources.

The most attractive way to increase total output is to improve the efficiency with which labour and other resources are combined, so that output is maximized with minimum input.

photo: John Willard

Early kitchen equipment

What Determines the Level of Productivity?

Several of the most significant factors affecting productivity are discussed below. As you read, consider how Canada can influence these circumstances during your working life, in order to encourage higher productivity.

The structure of the economy The structure of the Canadian economy has changed considerably over the past quarter century. In 1951, 56% of all jobs were in goods-producing industries and 44% were in the service-producing industries. By 1975, this balance had more than reversed itself. In that year, 35% of all persons employed were producing goods while 65% were producing services.

There is nothing "wrong" with this evolving employment pattern; it is characteristic of maturing economies. But the shift complicates any long-term overview of productivity in the total Canadian economy, for two reasons. First of all, output in the service industries is hard to measure on a consistent basis over long periods of time. That makes it hard to get a good reading on the relationship between output and labour input. Secondly, productivity growth has traditionally been somewhat higher in the goods-producing industries than in the service-producing industries. Part of this difference may reflect differences in measuring productivity between the two types of industries.

On the measurement side, output of the goods-producing industries is tangible. It can be picked up, turned over and counted. Measurability isn't as clear-cut in many service industries. Even in the personal services field, such as dry cleaning, hair styling and travel agencies, quality improvements that have come about through research and experience are not easy to measure. A coat dry-cleaned today is statistically the same as a coat dry-cleaned 20 years ago – it's one coat. But it can be argued that due to improvements in the use of chemicals, the coat is cleaner and should be counted as "more". Measuring quality change in goods sometimes presents problems, too. Consider an example. How would you measure the pollution emission control equipment that has been introduced into automobile production in the past few years? Would a car with such equipment be 10% "more car" than one without? 25%? 50%?

The problem of measuring service productivity is especially severe in relation to governments, which are often criticized for inefficiency. So far it has proven impossible to measure directly and comprehensively the "output" of governments. No technique has been devised for adding up the "output" of pieces of legislation or fire-fighting services and garbage collection services. A stop-gap solution has been to calculate the cost of all government inputs, and to call that sum "output". But this eliminates the possibility of measuring output per unit of input in government – the ratio of output to input will always be 1:1.

Efforts to improve productivity usually achieve the most dramatic results through the introduction of new "technology" in a production process. Traditionally, the key has been increasing the use of capital* by labour; the same number of workers using more equipment turn out more product.

Automation, which involves the use of machinery to perform routine tasks the same way over and over again, has received credit for greatly improving labour productivity in the goods-producing industries, especially manufacturing. In addition, experience built up through the use of familiar equipment and procedures, and "learning by doing", has contributed to labour productivity.

Because of long-held social attitudes toward "service", automation in the service industries has been implemented slowly. Applications, however, are becoming more common. For example, trial equipment recently introduced in a few large supermarkets electronically reads coding pre-printed on a wide variety of items and reports sales back to a computerized inventory system. These machines automatically perform many tedious pricing and stocking tasks and raise the overall productivity of the stores using them. The computer is also playing a very prominent role in such service industries as banking and air travel.

* *See more about capital on page 14*

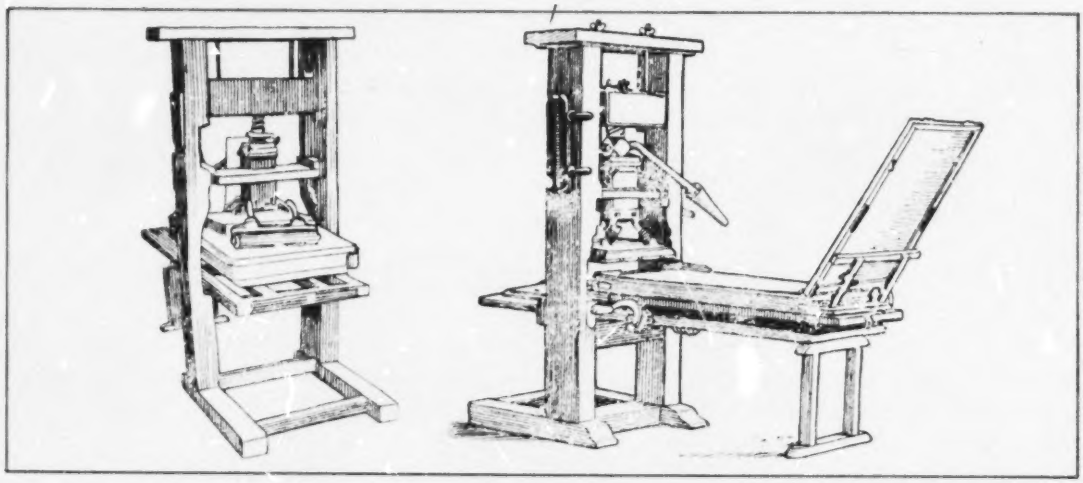
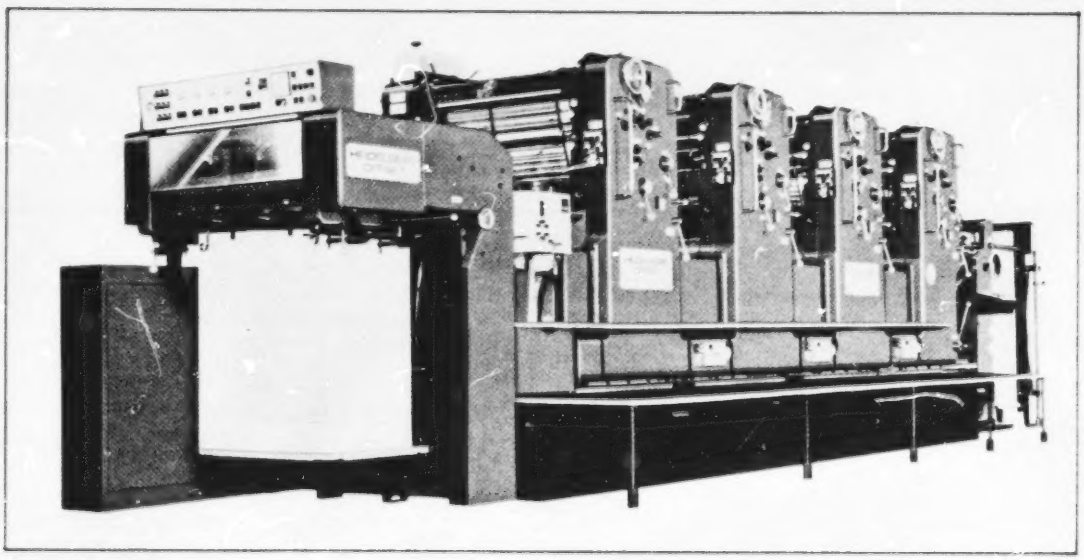


photo: The Picture Gallery of Canadian History

In the past, cheap energy encouraged labour-saving mechanization that resulted in higher productivity. As energy prices rise, productivity gains are wiped out by higher costs. For now, North American industry is "locked in" to high-energy-consumption production techniques. In the longer run, substitutes for traditional energy sources will have to be developed, and our industries modified to accommodate them.

Clockwise from top:
"The First Press in Upper Canada"
Foot treadle-operated, hand-fed platen press
Heidelberg offset press



Experts in many fields such as psychology, computer science and operations research, are studying the possibilities for innovation in the service industries. Gains will thus be made not from "working harder", but from "working smarter", through improvements in management and organization.

The state of the economy The economy experiences fluctuations in activity levels, and studies show that there is a rough pattern to these fluctuations. The four phases of this pattern are recession, trough, expansion and peak. The period from one peak to another is called a "business cycle". These relatively short-term fluctuations in the level of economic activity influence our productivity performance. The effectiveness of total resources used in an industry varies considerably from high points (peaks) to low points (troughs) in the business cycle.

It has been observed that when the economy is slack, labour productivity grows slowly or declines. Under deteriorating economic conditions, employers first cut back on hiring, then cut back on overtime, ease up on production schedules and eventually lay off workers. Until lay-offs actually occur, and despite continuing willingness and ability to work as hard as ever, productivity suffers. It suffers because all resources are under-utilized and output per unit of labour input is less than it could be.

photo: Miller Services

Office workers before the computer era

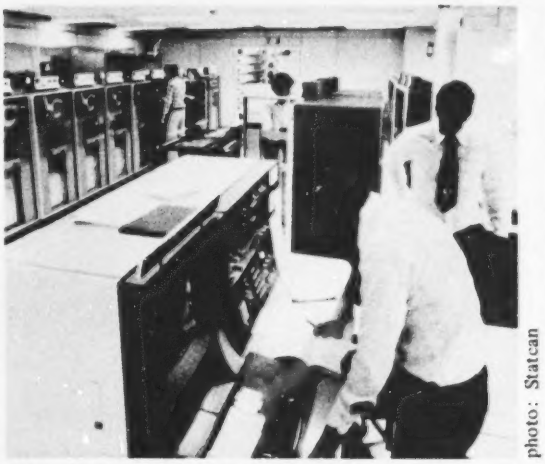


photo: Statcan

Much of the tedious work being done by a computer

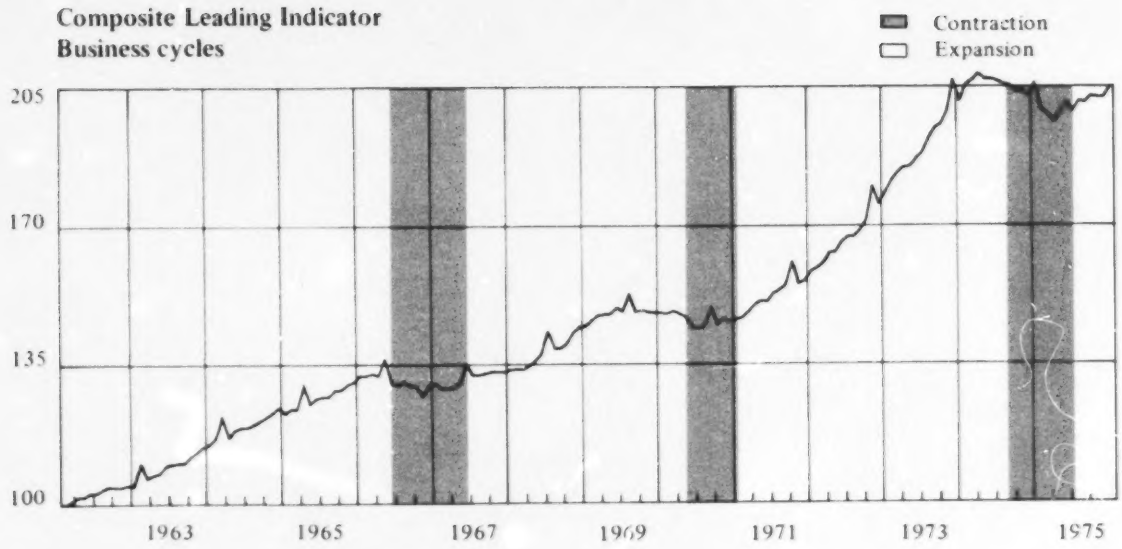
During an upswing in activity, the reverse process occurs. Those who have not been laid-off earlier resume a more normal work schedule, in order to fill new orders. As demand increases, workers are hired back. Overtime picks up and new workers are hired. Output per worker reflects this process and rises.

Employers generally try to avoid lay-offs for as long as there is any work at all. This is partly due to the administrative expense of rehiring former workers who are still available, and training new workers to replace those who have taken other jobs. On the other hand, they will try to stall hiring new workers for as long as possible in a recovery, for similar reasons.

The varying intensity of economic activity from 1961 to 1975 has had some effect on productivity. As shown in the accompanying graphs, output, productivity and man-hours grew at different rates during the period. Total output in the non-agricultural, goods-producing industries grew at an average annual rate of 6.1% from 1961 to 1971 and by 3.2% per year from 1971 to 1975.

A breakdown of these totals indicates, however, that the increase in man-hours and the increase in productivity (together accounting for the increase in output) occurred at different rates. Between 1961 and 1971, man-hours increased at a rate of 1.7% per year and productivity increased at a rate of 4.3% per year. Between 1971 and 1975, man-hours increased at a rate of 2.0% and productivity at a rate of 1.2%.

Composite Leading Indicator
Business cycles



Compiled by J. J. Singer Consulting Economics Limited

Fluctuations in levels of economic activity follow a pattern, referred to as the "business cycle". Each phase of the business cycle has certain recognizable characteristics, which can be measured. Studying changes in these measures helps economists to monitor each phase of the business cycle, and to anticipate changes before they occur. This provides all sorts of economic decision-makers – households, businesses, governments – with some basis for their plans.

The above graph presents one measure of economic activity, designed to indicate changes in the business cycle before they occur. Hence, it is called a "leading indicator". It is a "composite" leading indicator, because it is made up of nine separate leading indicators, each one measuring some aspect of economic activity. In the past these nine measures have tended to increase before the general level of economic activity increased, and to decrease before activity decreased. The combination of nine into one contains more information and thus is a surer measure than any single indicator would be.

Three indicators which make up a part of the above composite leading indicator are: housing starts in urban areas, the ratio of actual output to full-capacity output in the manufacturing industries, and the average number of hours worked in a week in the manufacturing industries. Can you explain why changes in these indicators would lead changes in the overall level of activity in the economy?

Leading indicators "lead" changes in overall economic activity by different lengths of time from cycle to cycle. For example, the lowest point of the above composite leading indicator in the 1974-75 recession came in March 1975, while the trough of the cycle didn't occur until August 1975. During the 1970 recession, the indicator reached its lowest point in June, while the cycle itself didn't bottom out until December.

The composite leading indicator presented above is just one way to keep track of economic activity. Different people study different indicators, some quite similar to the above measure, some completely unrelated. The WALL STREET JOURNAL once reported that the "goat index" had proven a useful indicator of changes in the economy. Evidently, when the economy begins to slow down, the U.S. goat population goes up!

Annual Average Percentage Change
Output, Man-Hours, Productivity
1961-1971 and 1971-1975

	1961-1971	1971-1975
Commercial non-agricultural (*) goods-producing industries		
Output	6.1	3.2
Man-hours	4.3	2.0
Output/man-hour	1.7	1.2
Commercial Service-producing industries (**)		
Output	6.1	5.5
Man-hours	3.1	4.2
Output/man-hour	2.9	1.3

(*) Commercial non-agricultural goods-producing industries include forestry, fishing and trapping; mines, quarries and oil wells; construction; electric power and gas distribution; and manufacturing.

(**) Commercial service-producing industries include transportation, communication and other utilities; trade, finance, insurance and real estate; health, recreation and other personal services; and other miscellaneous services.

In the latter period, the slowdown of productivity growth occurred alongside slower growth in man-hours worked. The result was that total output increased at about half the rate of the earlier period.

The picture is somewhat different in the service-producing industries. As in the industries described above, the annual average rate of growth of output in the service industries was lower from 1971 to 1975 than it was during the preceding decade. However, the slowdown was much less severe – 6.1% per year in the earlier period compared to 5.5% per year in the more recent period. The growth in man-hours worked from 1971 to 1975 was stronger than during the decade of the sixties, while productivity growth was weaker.

These figures call for a few comments. First of all, they point up the differences in productivity gains between goods-producing and service-producing industries. Secondly, they indicate that the impact of the business cycle on productivity in the service industries is less severe than that on goods industries. The explanation for this phenomenon lies partly in the discretion people have over buying goods compared to buying services. For example, automobile maintenance expenses (service) can't be put off as easily as car-buying decisions (manufacturing). In addition, producers build up inventories of goods, and when spending slows down, they draw on those inventories rather than continue to produce goods at the same rate. Service-producing industries can't build up inventories the way goods-producing industries can. Hence demand for services is relatively stable over the business cycle. Employers don't have to adjust their production levels, and employees aren't "underemployed" as often as they are in the goods-producing industries.

A third comment explaining the statistics chosen for comparison. Commercial industries were chosen because, by definition, they produce goods and services that pass through the market (e.g., excluding government). This means that they can, therefore, be assessed relatively easily. Agriculture is omitted from the goods category, because productivity in agriculture is affected by a host of factors that are peculiar to agriculture.

These factors are to a large extent outside the range of short-term influence by business, government or labour.* Finally, the split between goods and services is reported because, many goods produced in Canada are

* *In fact, a dramatic increase in productivity has occurred in agriculture over the years, thanks to a number of factors including the extensive mechanization of production, the greater use of chemicals and fertilizers, and farming on a larger scale than previously.*

subject to competition from imports, or are offered for sale to non-Canadians. On the other hand, most services are produced and consumed locally. For that reason, the impact of productivity on our international competitive position in services is of lesser importance than our productivity performance in goods.

The scale of operations One general-purpose approach to improved efficiency is summed up by the phrase "economies of scale". The principle is that as the size of any operation increases, specialization becomes possible and profitable at each intermediate stage of the operation. This specialization leads to greater efficiency by each individual in the process (sometimes through the use of highly specialized equipment). Of course, benefits from larger-size operations do not accrue indefinitely. Beyond a certain point, the cost of further enlargement is greater than the revenue produced by the scale of the extra output. The challenge is to find the scale of operations at which efficiency is highest.

For example, Canadian automobile manufacturers have made extensive use of the assembly-line technique to achieve high efficiency. On an assembly line, workers have the tools they need immediately at hand, and the work comes to the worker instead of the worker going to the work. Each worker on the line specializes in one relatively simple task in the assembly of an automobile. By application of this technique, production units have become very large and very efficient. In order to maintain control of these huge factories, communications experts have had to devise complex systems for keeping track of materials and schedules. Without such systems, these operations would be too large to manage, and efficiency would break down.

The principle of "economies of scale" applies in a broad range of everyday activities. It is especially significant to understanding the problems of manufacturing in Canada, which lead to lower efficiency than in some other countries. Our operations have not reached the optimal size. There are several reasons for this state of affairs. First of all, the size and geographical distribution of the Canadian population means that Canadian markets are generally too small to support optimum-size manufacturing plants. Due to tariff and other barriers to trade, Canadian manufacturers cannot increase their scale of operations through sales abroad. According to York University economist Don Daly: "Canada is the only high-income country in the northern hemisphere that does not have something approximating free trade access to markets of 100 million people or more," either domestically or through trade. The result, as reported in a recent study by the Economic Council of Canada, is that the average manufacturing plant size in Canada is smaller than the average in the United Kingdom, the United States, France and Sweden and less than half that of the German Federal Republic.

photo: Robert Ragsdale

Automobile assembly line

The specialization and scale problem, however, is not entirely one of optimum plant size. In some Canadian industries, one large plant produces many different products each year. Each time a new product is run, production must be shut down and reorganized and machines must be retooled. This process takes time; output is lost and productivity suffers. Recent evidence suggests that short production runs in Canadian manufacturing are a more serious problem than plants that are too small.

The quality and quantity of "capital" As noted earlier, productivity measures customarily relate output to the labour time that went into producing that output. But obviously labour is not the only resource, or factor of production, in the process. Workers use machines and other equipment to achieve their output goals, and they work in buildings that often are tailor-made to the requirements of the production process. The buildings, tools, machinery and other equipment used by labour in production is referred to collectively as capital. This term encompasses everything from the reference books in a law office, to the cash register in a "fast food" restaurant to the blast furnace in a steel mill – the list is virtually endless.

One basic idea in understanding productivity is that the more capital a worker uses on the job, the more "productive" his or her labour usually will be.* With greater mechanical and other specialized assistance, the individual generally expends less physical energy. He or she works more effectively, uniformly, and often, more safely. In some occupations, relative freedom from physical strain enables the worker to devote more mental energy to the work, and productivity gains are won through inventiveness.

The quality of the capital used must be high, or its best productivity advantage will not be realized. For example, a seamstress in a clothing manufacturer's plant may have the fastest fingers in the factory, but if her sewing machine breaks down regularly, her productivity will suffer.

The quality and size of the capital stock depends on many things, among which are the level and timing of investment; the intensity of research into new techniques and methods; the development and adaptation of appropriate technologies; and, of course, maintenance.

Businessmen invest in capital in order to maximize the return from all resources. Business spending on machinery, equipment and industrial structures varies from year to year. Sometimes such investment increases, sometimes it decreases, sometimes the changes are large, sometimes they're small. But the labour force, the number of people looking for jobs, keeps right on growing. And the Canadian labour force has been growing at the fastest rate of any among the industrialized countries of the world.

Assuming that there is some demand for workers' services, investment in capital is necessary to provide all these new workers with jobs. Investment in capital must match the growth of the labour force in the areas where that labour force is needed. In order to maintain high levels of overall productivity for new workers and the workers they join, investment must be equal to the task of replacing old machines when they wear out or become outdated. Finally, spending on capital must include adequate maintenance for existing equipment.

And all this will only keep the capital/labour relationship steady. Increased productivity through more capital for each worker requires even more spending.

The timing of investment in capital is important, not only because it must accomodate the number of new job seekers, but also because of improvements made in equipment. Innovation, the introduction of new techniques into a production process, has long been recognized as a major source of productivity improvement. Innovation is often (not always) achieved through the use of new machinery.

It is sometimes said that Canada does not spend enough on research and development that could lead to innovation. The idea is that if many researchers were working full tilt, they would discover products and processes that would make our production more efficient. Since Canada doesn't support as much R & D as other industrialized countries, it is argued that our productivity suffers.*

But there are other points of views on this subject. It is said as a counter-argument that research is a luxury item. Scientists, and other specialists, working with expensive equipment must be

* *The output per unit of other inputs, however, may decrease, if labour is "over-capitalized".*

* *In addition, Canadians appear hesitant to develop and implement the ideas they do come up with. The Science Council of Canada found that new products and processes developed in Canada are often introduced into production elsewhere.*

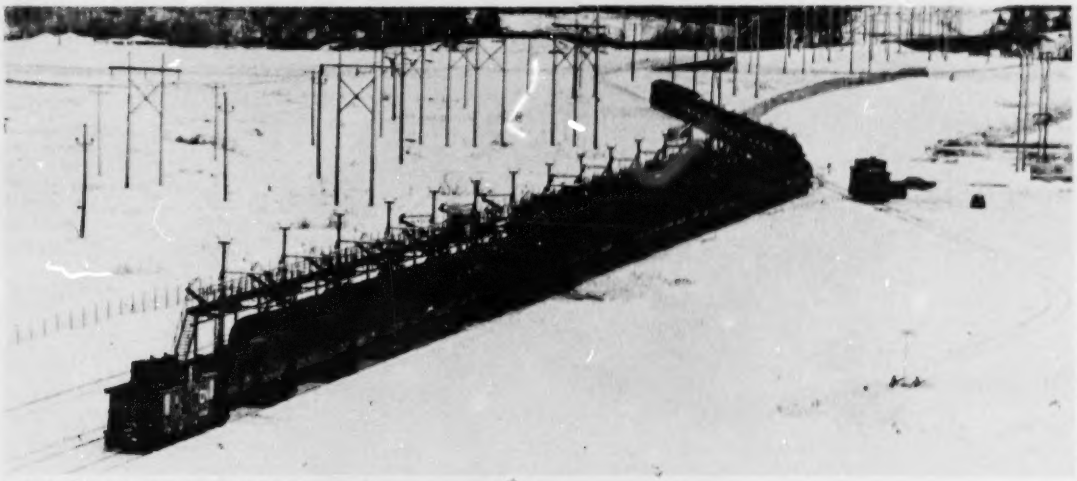


photo: Procor Limited

Golden Eagle Bunker Fuel Oil Unit Train

paid high salaries and there is no guarantee that their work will pay off for industry. On the basis of some studies, it is argued that major productivity benefits can be gained by making sure that all producers obtain information about existing "best practice" technology. The Federal Department of Industry, Trade and Commerce recently found large differences between the productivity levels of various Canadian manufacturing plants of about the same size that produce the same product. This evidence, it is said, points to the need for greater emphasis on spreading the word. Further studies suggest that Canada is slow to introduce new technology that represents refinements in the "state of the art", even if they aren't new discoveries. If this is the case, it means that, although capital is available, sometimes in abundance, productivity is still lower than it could be.

Innovation is frequently a response to new inventions or other discoveries, but sometimes it is in self-defense. For example, in late 1973, the oil exporting countries of the Middle East set in motion a series of events that resulted in current world oil prices four to five times higher than they were in early 1973. Now, in many industries, some of the equipment that was considered "efficient" before that change in oil prices looks "inefficient" and must be replaced. The cost of running those machines increased just as if they were broken-down or out-of-date.

Thus, the level and timing of investment in capital is important to ensure that each worker has the appropriate amount and type of equipment with which to work. But the cost of providing each worker with more and better capital must be weighed against the value of the increased output produced before final judgment can be made on the practicality of an investment. (Remember that like "km/h" and "rpm", productivity, and efforts to improve it, can be assessed only in conjunction with other information.)

Labour One of the most important determinants of productivity is found in the labour force itself. The age, health, education and training of Canadian workers explain much of Canada's labour productivity performance.

The influence of age is difficult to sort out. Younger workers are less experienced, but often better educated and more adaptable. Older workers can draw on the benefits of experience as well as greater attachment to a job. The growth of the labour force over the past decade has been dominated by younger workers and women, and neither group has much managerial experience. Hence, labour productivity growth as a result of managerial expertise was probably slightly less than it would have been had labour force growth been balanced differently during this period.

The health of the labour force also influences overall productivity, but there is little direct information on this factor. Governmental efforts to improve Canadians' health are rarely considered as "investment in human capital", but their effect on productivity has probably been significant. Further, government business and labour have all worked to reduce industrial accidents. Although safety programs are not seen as productivity enhancers, they can and do have that effect.

Education is the most clearly identifiable element in the development of a first-class, high-productivity labour force. "Education conditions both the types of work an individual is able to do and his efficiency in doing them." Canadians have invested vast sums of money in education over the past quarter-century. One result is that while less than one-half the Canadian population aged 14 years and older had more than Grade eight education in 1951, more than two-thirds had exceeded the Grade eight level in 1972. During that period, the proportion of the population 14 years and older with some post secondary education climbed from about 7% to 18% . Although the average level of formal education in Canada continues to be lower than that of the United States, our educational advancement is estimated by the Economic Council of Canada to have accounted for about one-quarter of the contribution of labour to growth in total output from 1946 to 1967.

In addition to general education, the Canadian labour force benefits from vocational training at secondary schools and community colleges. The Canada Manpower Training Program, run by the federal government, enables adult workers to obtain specialized skills that are of use in industry. Although these efforts are aimed mainly at minimizing unemployment, they enrich the Canadian economy with workers well-qualified to handle modern technology efficiently.

The level of managerial ability is also important in labour productivity. Management effectiveness is a combination, sometimes rare, of experience, common sense and education. It appears that Canadian industry may be suffering a shortage of highly-qualified managers. Formal training in management is claimed to have contributed to more

photo: Oakville Museum

Oakville Railway Station, early 1900s

rapid development and use of new products and processes in production and to organizational innovation. It is argued by some experts, therefore, that more attention should be paid to the benefits of specialized education in management.

In summary, a healthy, well-educated, fully-employed labour force is a basic requirement for strong productivity growth. However, labour must work in a constructive atmosphere, with top-notch equipment and in an efficient organizational structure to achieve its full potential.

The Role of Government Government actions play a crucial role for productivity, both in setting the general conditions within which the economy operates and in initiating specific programs designed to increase productivity.

The more general influences include nearly all the activities of a government today, since in greater or lesser degree most of these will have some economic impact. Some of these predominate, however. Perhaps the most important is the general tone of confidence (or lack of it) in present and future economic policies of government. This has an important effect on investment for the future, not only in capital goods but in personal commitments to learning skills.

The "economic climate" can be influenced by the tax system, and the extent to which it tries to stimulate economic activity. Another influence is the tariff, which determines the degree of competition from abroad. The general stance of government monetary policy (tight or ample credit; high or low interest rates) is also important. Still another factor is the balance of government budgets. Broad social programs have both positive and negative economic implications. Positive effects are achieved through changes in total spending in the economy. Negative effects are felt through higher taxes that may discourage initiative.

In addition to these and other very broad influences there is the more basic question of the efficiency with which governments carry out their functions. There are many instances that could be given, but communications (the post office) and transportation (highways, public transit) are sufficient to make the point.

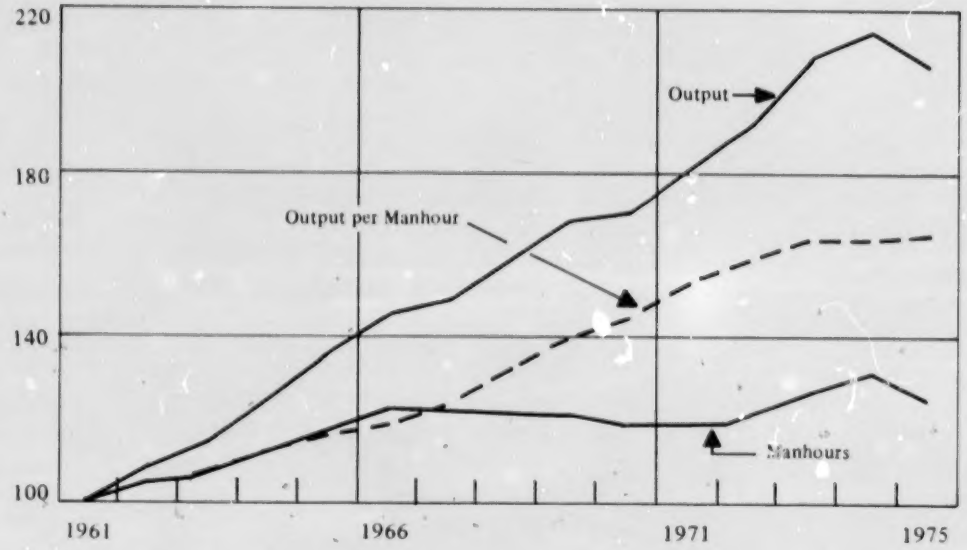
Some programs of government are aimed more narrowly and positively at increasing productivity. Programs administered by the federal Department of Industry, Trade and Commerce focus on research and development activities in the manufacturing industries and contribute to the funding of experiments in innovation. Similarly motivated programs conducted by the National Research Council facilitate the employment of Canadian scientists by industry. These programs cost close to $200 million during the fiscal year 1975-76.

Industry, Trade and Commerce also stimulates the adoption of "best-practice" technology through its Program to Enhance Productivity (PEP) and its Technical Information Service. Under PEP, consultants are brought into firms to assist in problem-solving, while the Technical Information Service advises companies that tackle problems on a do-it-yourself basis. Another program recently announced by the federal Department of Labour will encourage companies to investigate ways in which the potential of women employees can be developed. The new program will propose training and other equal opportunity guidelines, and will assist companies in setting and achieving their own goals in this area. No attempts have been made to estimate the lost productivity that has resulted from the inadequate use of women's talents. Although we do not know the dimensions of this problem, the new program should speed the long process of correcting it.

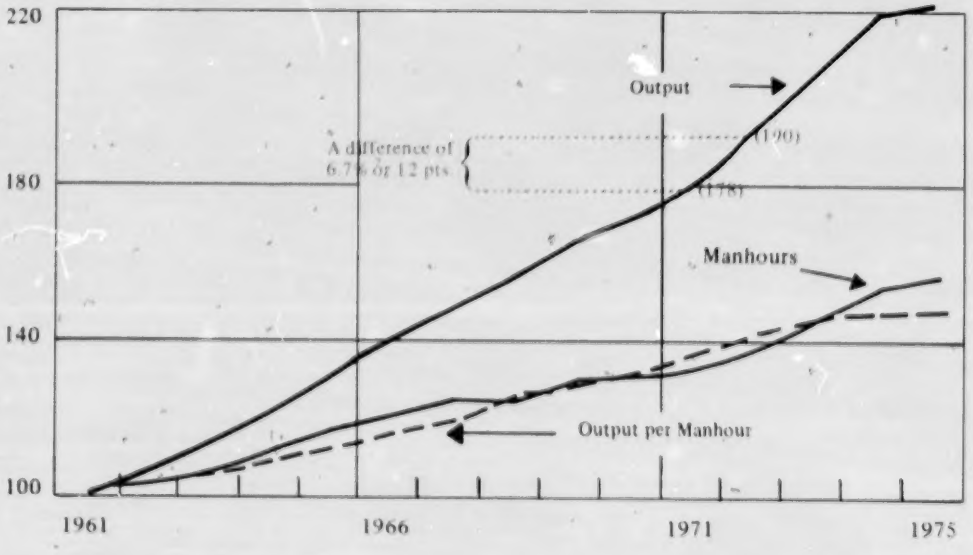
Several of the provincial governments also have similar programs, aimed quite often at helping small or medium-sized businesses with their special problems.

Efficiency can be improved in many ways. For that reason, it can be said that all government programs devised to encourage the smooth operation of the economy contribute to higher productivity. Thus, the programs named above are a small portion of total government efforts to improve production efficiency.

Commercial Non-Agricultural Goods-Producing Industries, 1961 - 1975
1961 = 100



Commercial Service-Producing Industries, 1961 - 1975
1961 = 100



Source: Statistics Canada, Aggregate Productivity Measures
Cat. No. 14-201

Graphs by J.J. Singer
Consulting Economics Limited

Measuring Productivity

As the heading indicates, the graphs on the facing page present indexes of total real output, output per man-hour, and total man-hours worked, in two major sectors of the economy. But just what do these indexes tell us?

There are many types of indexes all of which are used as indicators or measures. Those shown on page 18 are statistics showing a percentage comparison of any chosen point to a fixed point of reference. The reference point chosen is the year 1961. Each index shows the percentage relationship between activity in the year chosen and activity in 1961. For example, the output index in the top graph shows output in the non-agricultural goods-producing industries in years after 1961 as a percentage of 1961 output in those industries. The procedure for constructing these indexes can be roughly illustrated with reference to the example of output.

To start with, statisticians calculate the total real output of the relevant industries in 1961. That total becomes the basis for comparing output in other years, and is given the base value of 100. In order to compare production in 1965 to that of 1961, total real output in 1965 is added up and divided by total real output in 1961. The quotient, multiplied by 100, indicates the percentage relationship of output in the two years. These basic steps are followed in calculating the output per man-hour, consistently defined and man-hours worked, consistently defined.

Indexes are very useful for comparing the same activities at different points in time. But there are a few points to remember in interpreting them correctly. For example, the total real output index in the graph for the service-producing industries is about 178 in 1971 and about 190 in 1972. That means that total real output was 78% greater in 1971 than it was in 1961, and 90% greater in 1972 than in 1961. From these data, it can also be seen that total real output in those industries increased 6.7% from 1971 to 1972, while the change in the index was about 12 points.

It is also important to note that indexes reflect differences and not absolute levels. Because of this, the three indexes can be presented in one graph, even though they describe three different things. The statistician can show how each element has grown since 1961 without the confusion of comparing apples and oranges!

As shown, total real output in both sectors of the economy has climbed steadily since 1961. But note the dips and wiggles in the output per man-hour and total man-hours worked indexes.

When it comes to measuring productivity, and the trends it is following, we face a dilemma that is common in applied economics – there is no single body of data that is accepted as being final, accurate and non-controversial. Productivity statistics are available, both here and in other countries, but they are subject to periodic massive revision. As well, statistics are always subject to several interpretations, depending on the way in which they are presented and the use that is made of them.

A recent instance in Canada involving the prestigious C. D. Howe Research Institute demonstrates the problem. In February this organization, in its Policy Review and Outlook, 1976, using then available data, concluded that productivity was much lower in Canada than in the United States. In May, only three months later, the same organization issued a press release reporting that the U.S. official figures had been drastically revised downward. This revision meant that the comparison had changed materially, showing a much more favourable position for Canada. One can only agree with the Institute's observation that "one of the perils of economic analysis is that statistics are often subject to revision . . ."

Problems of interpretation also arise. Particularly is this true of the periods that are selected for comparison, since productivity is subject to cyclical change, as we have pointed out. With all these limitations in mind we have presented below only the available official statistics for Canada, prepared by Statistics Canada. We have presented these for two periods in which trends appeared to be evident; at the same time it must be acknowledged that the data could be looked at in other ways.

One important group of goods-producing industries other than manufacturing and agriculture include forestry, fishing and trapping; mining, quarries and oil wells; construction; and electric power and gas distribution. Although these industries are quite different, they are lumped together because they all produce goods and they aren't manufacturing.

Output per man-hour in these industries grew at an average annual rate of 4.3% during the decade 1961 to 1971, which was the same as the rate for all commercial industries (goods and services). But compensation per man-hour rose more rapidly than productivity, so unit labour costs* increased by 3.5% per year, as compared to 2.8% per year for the whole economy. During the period 1971 to 1975, these costs rose at an average annual rate of 14.5%, the combined effect of a 14.2% average annual increase in compensation per man-hour, and a small decline in productivity.

Among the goods-producing industries, productivity in manufacturing is of most interest. A healthy manufacturing sector is one characteristic of a well-balanced economy, one with good prospects. One reason for this is that manufacturing requires much high-quality labour and provides many relatively high-paying jobs. If more Canadians are employed processing our raw materials for sale in manufactured form, we use up our natural resources more slowly than if we sell raw materials in order to import finished goods.

The size of the manufacturing sector relative to the total economy has shrunk over the past couple of decades. In 1961, manufacturing output was 26% of the total domestic product, while in 1974, that share had fallen to 22.7%. During the same period, employment in the manufacturing sector fell from 24% to 22% of the total. These facts make the manufacturing sector the focus of most productivity debate.

The manufacturing industries account for between 1.5 and 2 times as much output as the other goods-producing industries under consideration. If cost competitiveness in manufacturing is good, it can outweigh the performance of the other industries and improve the picture for the goods-producing industries as a whole. To some extent, that offset occurred. Between 1961 and 1971, output per man-hour rose at the same 4.3% average annual rate as in the other goods-producing industries, but due to the slower growth of compensation per man-hour, unit labour costs increased by only 1.9% (compared to 3.5% in the other industries, as noted above).

During the period 1971 to 1975, these relationships changed somewhat, although manufacturing continued to lead the other commercial non-agricultural goods-producing industries. Productivity in manufacturing grew at the rate of 1.9% per year, with unit labour costs increasing by 8.9% (compared to 14.5% in the other relevant industries – again, see above).

* *The cost of the labour that it takes to produce each unit of output.*

Summary and Conclusion

During the past 30 years, Canadians have become accustomed to a continuously rising standard of living based on rapid economic growth. Expectations conditioned by this experience demand an awareness of the importance of efficiency, and high productivity, if Canadians are to achieve their economic and social goals.

Productivity depends on the role played by all segments of society – business, labour and government at all levels. Increased economic efficiency will require effort from each of these groups.

This effort must include:

- attention to the implications of changes in the structure of the economy;
- reduction of the impact of the business cycle on resource use, such that labour and other factors of production are not often "underemployed";
- programs to facilitate the reorganization of production, such that full benefits can be derived from specialization and optimum-sized operations;
- continuous strong investment in high-quality capital which embodies the most up-to-date technology available;
- a social milieu in which members of the labour force have broad access to health and education services, and work within organizations structured to enable them the fullest realization of their potential;
- an aggressive approach to competition in international markets, one that reflects our ability to learn from our trading partners.

In October 1976 the Government of Canada distributed a working paper – ***The Way Ahead*** – that looked at the "economic and social challenges" facing Canadians. In it, the issue of productivity, among other national questions, was discussed with a sense of urgency. The paper pointed to evidence suggesting that "productivity may grow less rapidly than it has over the past thirty years".

This fact, coupled with slower growth in the labour force, may result in "confrontation . . . between lower rates of future output growth and increasing income expectations of Canadians".

The paper referred to structural adjustments in the economy that will be made necessary by this changing growth scenario. The authors warned that such adjustments may be made more difficult "by continuing short supplies of energy and food and increasing demands by the developing world for a better distribution of wealth".

"Policies will have to be developed to ensure that these necessary adjustments occur with the least possible disruption and do not lead to a renewed outbreak of inflation. An important component of such policies will be to establish measures to increase productivity."

The time is right for Canadians to understand clearly the implications of our productivity performance for our present and future standard of living, and to act on that understanding.